



How to Create Research Questions

Many engineering educators are interested in conducting engineering education research (EER) while teaching. A research inquiry begins with research questions, which serve as an “anchor” throughout the research process. How can we frame research questions? What are some of the criteria for self-assessing our own research questions? This post aims to address these questions.

In general, research questions come from a gap in practice or literature. Therefore, it is important to specify the problem that needs to be solved. Then, you can phrase a question to address the problem. Good research questions will guide your research plan and help determine your decisions along the way. There are many paths to framing research questions. Ideas may initially stem from your reflections on your own teaching practice or readings of current issues in engineering education. You may discuss your preliminary ideas with colleagues to refine your thinking. Reading about how others have engaged with EER on the topic of your interest also helps inspire ideas. Further, theoretical perspectives on your research topic can inform your research questions as well. Eventually, your initial ideas about a research topic narrow down to one or a few specific research questions. One of the most common mistakes people make is to create research questions that are too broad, e.g. “how do my students learn?”

If you are unsure what is considered a solid research question, the FINER framework can help. This is a framework used in clinical research (Hulley et al., 2013) and by some academic publishers, such as Elsevier. FINER represents the following five criteria for evaluating research questions:

- **Feasible** – Can your research question be answered given the resources you have, including time, expenses, technology and expertise? If you choose to conduct an empirical study that involves human participants, how are you going to have access to the individuals who have the knowledge or experience for your research? Do you have the knowledge and skills to analyze the data you going to collect? Many engineering educators have a wealth of expertise in quantitative research but may find it challenging to analyze qualitative data, such as text-based data.
- **Interesting** – Your research question must be something that *you* find interesting in the first place. You may be interested to explore a question for various reasons, including your own curiosity and practical needs you have identified. Then, you ask: How can the knowledge gained from answering this research question contribute to practice and understandings of engineering education? Why should a funding agency be interested to fund the research asking this question?
- **Novel** – A good research question guides your research to fill a gap in a particular area of knowledge in EER. An in-depth review of what has been known and what research has been conducted on the topic will inform you of the existing gaps. If you are unsure, you can check on the proceedings that are made available by EER communities such as the [Canadian Engineering Education Association](#) (CEEA) and the [American Society for Engineering Education](#) (ASEE).
- **Ethical** – EER often involves the participation of engineering students, alumni or educators. We as researchers must be committed to showing respect for individual persons and concern for any potential impact of research on individuals’ welfare, and treating people fairly and equitably. Our research questions must demonstrate these core principles for research ethics.

From the start of our research, we need to consider how to protect individuals' privacy and ensure confidentiality of their information throughout the study. More details on the ethics of human research can be found in [another Research Snack](#).

- **Relevant** – The research addressing your questions needs to be “well-timed” and lead to research outcomes that are relevant to particular educational practice or current discussions on matters in engineering education. You could ask yourself: Why do your research questions need to be answered at this particular time or place?

When framing your research questions, you can also consider what is the nature of your proposed research? Your research questions can be descriptive, relational or causal ([Trochim, 2000](#)). Descriptive and relational are also sometimes called observational.

Descriptive	Relational	Causal
<ul style="list-style-type: none"> •Aiming to explore what is currently taking place. •e.g. What are the experiences of students who have followed extant engineering transfer pathways in Ontario? (Smith & Frank, 2020) 	<ul style="list-style-type: none"> •Aiming to determine associations between potentially linked objects. •e.g. Do the identified WeBWork usage patterns relate to student exam outcomes? (d’Entremont et al., 2020) 	<ul style="list-style-type: none"> •Aiming to ascertain whether or not one object (such as an intervention) leads to particular outcomes. •e.g. Does a utility value intervention influence student interest in a multidisciplinary engineering design course? (Turoski & Schell, 2020)

Ultimately, how you have phrased your research will direct what methods you will use for data collection and analysis. Generally, you can use qualitative research design to answer “how” or “what” questions; and use quantitative design to address “what,” “do/does,” or “how much” questions.

d’Entremont¹, A.; Verrett, J.; Hu, S.F.; Abelló, J.; Negar M. Harandi, N.M.; Leonzio, T.; & Fong, W.C.W.F. (2020, June). *Multi-factorial patterns of online homework usage in engineering: A pilot study*. Paper in the proceedings of the annual Canadian Engineering Education Association conference.

Hulley, S.B., Cummings, S.R., Browner, W.B., Grady, D.G., & Newman, T.B. (2013). *Designing clinical research*. Philadelphia: Lippincott Williams and Wilkins.

Trochim, M.K. (2006). *Research methods knowledge base* (3rd ed.). Available online at: <http://www.socialresearchmethods.net/kb/>

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Smith, H., & Frank, B. (2020, June). *Investigating student experiences of engineering technology to engineering transfer in Ontario*. Paper in the proceedings of the annual Canadian Engineering Education Association conference.

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